TECHNICAL REPORT

1. INTRODUCTION

This report presents the results of an independent review of the criticality safety program at the Hanford Plutonium Finishing Plant (PFP). This review was requested by the Department of Energy's Richland Office (RL) to help benchmark the criticality safety program before a formal Operational Readiness Review is performed for the initiation of Phase 2 activities at PFP (Phase 2 is explained later, in Section 2.0 of this report). The review encompassed all elements of the criticality safety program impacting PFP, including management, supervisory, and criticality safety staff responsibilities; operating procedures; process evaluations; material controls; and the planned response to criticality accidents. A key portion of the review, the on-site phase in which the Team toured PFP facilities and interviewed PFP personnel, took place between March 30 and April 3, 1998.

The review was performed by a team of criticality safety experts under the direction of the Office of Nuclear and Facility Safety (EH-3) staff. The team members were chosen because of their experience in implementing, managing, and/or evaluating criticality safety programs for a variety of facilities. The team members were screened to ensure they had no substantial involvement in the criticality safety program activities they were expected to review. Biographies of team members are presented in the assessment plan, included as Appendix A.

This assessment was conducted by reviewing PFP documents; interviewing personnel from RL and the Hanford contractors involved in PFP criticality safety; and comparing information developed from the document reviews and interviews to evaluation criteria derived from the primary national consensus standard on criticality safety (ANSI/ANS-8.19)[3]. For each of the evaluation criteria, the Team developed detailed lines of inquiry to guide the review. As observations or information needs were identified, they were documented on special review forms and provided to the RL Facility Representative for response. Throughout this review, the Facility Representative was instrumental in facilitating the Team's interface with PFP personnel. The PFP contractors provided timely responses to Team questions and cooperated fully at every opportunity.

Section 2.0 of this report presents background that puts this independent review in context with recent and ongoing activities at PFP. Section 3.0 provides a summary description of PFP facilities. Section 4.0 summarizes the technical review results, including the evaluation criteria, findings, observations, and recommendations based on those criteria. Section 5.0 presents overall conclusions from the independent review.

2. BACKGROUND

The Plutonium Finishing Plant is expected to play an important role in reducing the potential risk to public and worker health and safety associated with storage of plutonium-bearing residues and wastes at Hanford. Having previously been used to produce plutonium metal ingots, called "buttons", and parts for use in manufacturing weapons elsewhere in the DOE Complex, the PFP today stores materials remaining from its production operations, including various quantities and chemical and physical forms of plutonium or plutonium-bearing materials. The PFP is needed to transform the plutonium into forms more stable and better suited for long-term storage, disposition or waste-disposal.

Because plutonium is fissionable, facilities and operations involving the handling of plutonium must be designed and conducted to prevent a criticality, the accidental creation of conditions in which nuclear fissions occur in an uncontrolled setting. Consequently, criticality safety is an important part of the design and operation of PFP. The criticality safety program defines how organizations, management, and staff integrate their efforts to fulfill the functions necessary to protect workers, the public, and the environment from the occurrence and consequences of a criticality at PFP. An effective criticality safety program requires high levels of integration and cooperation among all organizations and functions and a consistent high level of performance.

In 1996, a series of criticality safety incidents occurred while PFP was still conducting plutonium stabilization operations. None of these incidents actually resulted in a criticality, but each revealed a circumstance in which the margin of safety provided by the layers of physical and administrative barriers was reduced below the high level of protection DOE expects its facilities to maintain. BWHC, with FDH and DOE-RL support, decided to curtail plutonium-handling operations at PFP until the criticality safety program and conduct of operations could be strengthened to prevent a recurrence of the problems evident in 1996.

By December 1997, the contractors responsible for PFP operations determined the criticality safety program was ready to support resumption of limited plutonium handling operations. The plan was to resume operations in the Analytical Laboratory, the Process Support Laboratory, and the vault (Phase 1), then to resume plutonium stabilization operations (Phase 2) in spring 1998. In December 1997, the RL Assistant Manager for Facility Transition asked EH-3 to provide a quick evaluation of criticality safety prior to resumption of Phase 1 activities. The December 1997 evaluation focused on operational aspects of the criticality safety program pertinent to resumption of Phase 1 activities. By January 1998, RL was satisfied PFP had addressed the findings of EH-3's December 1997 evaluation and was ready to resume Phase 1 operations. The current review grew out of the December 1997 evaluation, in which RL and the evaluator recognized the need for a comprehensive review of the criticality safety program before Phase 2 operations begin.

Several organizations have vital roles to play in the success of the criticality safety program at PFP. The names and roles of these organizations are listed below.

The Review Plan (Appendix A) enabled the Team to evaluate whether the program meets the requirements of Standard ANSI/ANS-8.19, *Administrative Practices for Nuclear Criticality Safety*, as well as other ANSI/ANS-8-Series Standards referenced therein. These standards represent best practices for criticality safety programs and are mandatory under DOE Order 5480.24 and its successor Order 420.1 (which is not binding on the PFP contractors at this time). In addition, this review examined requirements of Defense Nuclear Facility Safety Board (DNFSB) Recommendation 97-2, *Criticality Safety*. This Recommendation dealt in detail with certain aspects of criticality safety that are covered more generally in the ANSI/ANS-8 Series standards. The DNFSB recommendations were used to develop several specific lines of inquiry for this review. The Team's understanding of the intent of DNFSB 97-2 was strengthened by the presence on the Team of two individuals previously involved in preparing the DOE's implementation plan responding to DNFSB Recommendation 97-2. These two team members are also charter members of the Criticality Safety Support Group formed, in response to DNFSB 97-2, to advise DOE management in criticality safety policy.

3. FACILITY DESCRIPTION

The PFP is described in a Safety Analysis Report[4] from which the following facility description is taken, verbatim.

Since 1991, the mission of the PFP has changed from reactive plutonium-bearing materials referred to as special nuclear material (SNM) processing to preparation for decontamination and decommissioning (D&D). The PFP is in transition between its previous mission and the proposed D&D mission. The objective of the transition is to place the facility into a stable state for long-term storage of SNM before final disposition of the facility.

The primary product of the PFP was plutonium metal in the form of 2.2-kg cylindrical ingots called "buttons". Plutonium nitrate was one of several chemical compounds that was produced as an intermediate processing product. Plutonium recovery was performed at the Plutonium Reclamation Facility (PRF). Plutonium conversion (from nitrate to metal) was performed at the Remote Mechanical C Line (RMC, or "C-Line"). Plutonium oxide was produced at the Remote Mechanical A Line

Organization	Role at PFP
Babcock and Wilcox Hanford Company (BWHC)	Operating contractor for PFP
Fluor Daniel Hanford (FDH)	Integrating Management Contractor (IMC) for the Hanford Site
Fluor Daniel Northwest (FDNW)	Enterprise company providing criticality safety engineering services to PFP
Dyncorp.	Subcontractor providing fire-fighting services for PFP
Exitech Hanford	Subcontractor providing generic criticality safety training services to PFP personnel
RL	Leading the DOE oversight of PFP

(RMA or "A-Line"). Plutonium processed at the PFP consists of both weapons-grade (95 wt% Pu^{239}) and fuels-grade plutonium materials. Both were processed through PRF. Weapons-grade material generally was processed through the RMC Line, although some fuels-grade material was processed prior to 1984. Both of these materials exist in storage throughout the facility in various residual forms left over from previous years of operations.

Plutonium recovery, plutonium conversion, and oxide production are no longer performed at the PFP. However, portions of the process are now used to convert plutonium into the more stable oxide form.

The following comprise the current, active processes at the PFP:

- SNM storage and support activities in the 2736-Z, 2736-ZA, and 2736-ZB Buildings, 2736-ZD vault, and the gloveboxes and vaults in the 234-5Z Building
- Reactive material stabilization in the 234-5Z Building
- Waste packaging and reactive residue storage
- Transfer operations in gloveboxes HC-227S/T in the 234-5Z Building
- Low-level waste and waste water treatment in the 241-Z Complex and 243-Z Building, respectively
- The PFP Analytical Laboratory (PFP AL), Standards Laboratory, and Plutonium Process Support Laboratory (PPSL) in the 234-5Z Building
- Facility support systems [e.g., heating, ventilation, air conditioning (HVAC), radiation monitoring, steam, electricity, etc.].

The following comprise the inactive processes that are not authorized under the current mission objectives:

- Plutonium recovery in the 236-Z Building
- Plutonium conversion in the 234-5Z Building
- Plutonium oxide production in the 234-5Z Building
- Waste treatment in the 242-Z Building
- The Laboratory waste concentrator.

4. TECHNICAL REVIEW

The results of the Team's review are categorized in this section by major topics as found in the Review Plan and in ANSI/ANS-8.19. Each area starts with an introduction, followed by evaluation criteria for that section extracted from the Review Plan, a list of findings and concerns, discussion of the basis for the findings and concerns, a listing of recommendations and suggestions, and, finally, a discussion of the overall element findings. Recommendations are identified for each finding. Suggestions are provided for information purposes and are not tied to findings or concerns. The Team identified some notable program strengths and these are noted where they occur. The Review Plan contains the detailed lines of inquiry for each of the major areas.

4.1 MANAGEMENT RESPONSIBILITIES

The objective of this element is to ensure that line management demonstrates ownership and participation in the NCS program as required by DOE Orders and Policies. ANSI/ANS-8.19 is a mandatory standard under DOE Order 5480.24[5] and establishes requirements for management relative to the NCS program. DOE Policy, 450.5, *Line Environment, Safety and Health Oversight*[6], establishes requirements for line management oversight of the NCS program.

Evaluation Criteria for Management Responsibilities

Management of the criticality safety program:

- Accepts overall responsibility for safety of operations
- Formulates and communicates criticality safety policy
- Assigns responsibility and authority to implement established policy
- Provides qualified personnel to furnish guidance appropriate to the scope of operations
- Establishes a means for monitoring the criticality safety program
- Participates periodically in auditing the overall effectiveness of the program
- Uses consultants and criticality safety committees, as appropriate

4.1.1 Acceptance of Responsibility for Safety of Operations

STRENGTH: *BWHC management demonstrates responsibility for criticality safety at PFP.*

In December 1997, BWHC management initiated a Criticality Improvement Team (CIT) to identify improvements to the PFP NCS. The membership of the CIT includes managers from several PFP organizations as well as the BWHC CSR. The Team interviewed members of the CIT and reviewed meeting minutes[7] and the results of the audit[8] of the CPS, postings, and procedures. The reports issued by the CIT identified numerous discrepancies between the controls established in CPS, postings and procedures. Facility managers and the CSR reported that communication between facility management and the criticality safety staff is open and frequent. Both CSR and CSE personnel expressed satisfaction with facility management's ownership of criticality safety. The CSR stated that when criticality safety problems are discovered, communications between facility management and criticality safety staff are prompt and corrective actions are implemented in a cooperative manner between the operating organizations and the NCS staff. The Team verified this through interviews with BWHC line management. In one instance, when it was found that vault operators were experiencing difficulty with the CPS and posting, a knowledge survey was developed and administered by the BWHC training manager and cognizant instructor. The results were used effectively to improve the training and alleviate much of the problem according to interviews with the CSR.

FINDING: *FDH considers implementation of criticality safety to be the responsibility of the subcontractors, and accordingly provides little oversight in this area.*

FDH managers interviewed asserted that the FDH responsibility is limited to issuing criticality safety guidance documents and conducting Facility Evaluation Board (FEB) annual reviews. As the Integrating Management Contractor (IMC), FDH assigned NCS Program functions to its Nuclear Safety organization and oversight functions to the QA (Quality Assurance) organization through the Facility Evaluation Boards (FEB). Procedure, HNF-PRO-334, *Criticality Safety General, Requirements*[9], assigns responsibility to design and implement the Project Hanford NCS program to FDH Nuclear Safety. The FEB, reporting to the President of FDH, has the responsibility for providing biennial oversight assessments of PFP. The Team interviewed three FEB members and reviewed the September 1997 PFP review report, FEB-97-0006-PFP[10]. The FEB displays a high degree of ownership for the oversight process. The September 1997 FEB review dealt primarily with the PFP self-assessment program and did not discuss PFP NCS performance across the broad scope of criteria contained in ANSI/ANS-8.19. In the overall context of the FEB duties, criticality safety is just one sub-element of Engineering, which is one of ten major program elements covered. The Team found that the FEB lacks sufficient frequency and emphasis to evaluate the effectiveness of the BWHC NCS program. M.H. Chew and Associates is also retained to provide additional oversight focusing on best management practices rather than on regulatory compliance. FDH has not utilized M.H. Chew and Associates to perform an assessment of criticality safety although one is scheduled for June 1998.

FINDING: *The Team found that FDH does not have a mechanism to assure that adequate funding is provided for NCS programs.*

Interviews with the FDH Nuclear Safety Manager and staff indicated that FDH does not monitor the BWHC budget process to assure that the PFP NCS program is adequately funded. Procedure HNF-PRO-334, does not assign the responsibility for assuring that PFP has the necessary resources to implement the NCS program. The Team determined from interviews with the AMF and the BWHC Principal Engineer serving as the NCS project manager for BWHC that the total BWHC NCS budget is approximately $735K of which $450K is earmarked for FSAR updates. The remaining $285K is the entire budget for the PFP operational NCS needs. Based on documented responses to Team observations, the FDH overhead charges for Government Furnished Equipment and the FDNW fee further reduces the net amount of funding available to PFP for NCS support. The BWHC NCS staff identified approximately $230K of additional criticality safety tasks for which funding has not been identified as well as the need for additional on-call CSE support. FDH Nuclear Safety was not aware of this and did not believe it was their responsibility to monitor BWHC NCS funding needs. DOE Policy 450.5 requires that "contractor line managers must acquire and maintain sufficient knowledge of the program activities in order to make informed decisions on safety resources for these activities." The Team found that this responsibility is not assigned within FDH.

The funding situation is further complicated by the method of obtaining CSER from FDNW. BWHC buys CSER directly from FDNW using task order contracts. Normally (and previously at Hanford) the CSR and CSE worked for the same company. BWHC buys products from FDNW, not a safety program. Under this arrangement the available funds from NCS support are drained by overhead fees imposed by FDH on every task order as well as the profit fee charged by FDNW.

FINDING: *The FDH Nuclear Safety organization does not have sufficient resources to staff an effective NCS program*

During interviews with the FDH Nuclear Safety Management and staff, they acknowledged that they own the procedures, but they do not consider the entire NCS Program their responsibility. Hanford procedure HNF-PRO-334 assigns responsibility to FDH Nuclear Safety to design and implement the Project Hanford NCS program. The FDH Nuclear Safety organization is also responsible for providing independent reviews of facilities and to assist the line organization with periodic criticality safety inspections upon request. The Team found through interviews with the FDH Nuclear Safety staff that these oversight responsibilities have not been implemented. The FDH Nuclear Safety budget was reduced 25% from the previous year. The reduced funding affected the criticality safety staffing level with one individual assigned only half-time to maintain the NCS Program. The single FDH Nuclear Safety engineer who has been funded to perform all the FDH criticality safety programmatic functions told the Team that he feels a personal responsibility for the overall criticality safety of the site. However, he spends his time primarily on procedure revision and maintenance. The Team found that the FDH Nuclear Safety organization is not funded sufficiently to staff and implement the NCS programmatic functions assigned in HNF-PRO-334.

RECOMMENDATION: *FDH should formally strengthen the oversight and assessment role of Nuclear Safety. FDH Nuclear Safety should review CSERs, CPSs, postings, infractions, corrective action plans, etc. to ensure that the PFP NCS program is implemented and advise FDH Project Direction as appropriate.*

RECOMMENDATION: *FDH Nuclear Safety should remain knowledgeable of the funding needs of the BWHC NCS program and should provide FDH Project Direction with reports and recommendations on required funding levels.*

4.1.2 Formulation of Criticality Safety Policy and Dissemination of Information

FINDING: *BWHC has not issued a PFP criticality safety policy.*

The Team reviewed the BWHC "Manual FSP-PFP-5-8, Plutonium Finishing Plant Administration", BWHC's policy and implementation document[11], and found that it does not contain a NCS policy. A BWHC self-assessment in October 1997 recommended that BWHC formulate and issue, to the facility, a concise NCS policy. The Team reviewed the draft BWHC corrective action plan[12] for the October 1997[13] assessment and found that it credited the Administrative Control in the PFP Operational Safety Requirements as NCS policy. The Team provided comments on the draft corrective action plan to BWHC and DOE-RL during the site assessment. The comments are included in Appendix B of this report. The purpose of the OSR is to establish the operating safety envelope for the facility and it is not industry practice to issue policy statements in an OSR. ANSI/ANS-8.19 requires that all personnel handling fissile material be familiar with the NCS policy.

FINDING: *The Team found that FDH has issued no Hanford wide NCS policy document that is binding for subcontractors.*

The Team interviewed FDH Nuclear Safety Management and staff. The interviews revealed that FDH considers its policy documents to be included in the Criticality Safety procedures issued through the HNF-PRO system. FDH management made a decision to incorporate policy into the procedures in the HNF-PRO "intranet" system. The Team found that elements of a policy statement could be extracted from the Purpose Section of these procedures. However, the current practice does not meet the intent of the ANSI/ANS-8.19 because these are procedures used to implement specific elements of the NCS program rather than communicate broad based management policy statements. Interviews with FDNW management and staff revealed that they are not aware of requirements to follow FDH procedures. FDNW is an enterprise company providing CSE support and all CSERs for PFP. For example, the scope section of HNF-PRO-539, *Criticality Safety Evaluations*[14], apply to all Project Hanford organizations with custody of fissile materials. FDNW does not have custody of fissile material, therefore, without explicit contract language in the task orders issued by BWHC, FDNW is not bound to the FDH procedure on criticality safety evaluations.

RECOMMENDATION: *BWHC should issue a formal PFP criticality safety policy.*

RECOMMENDATION: *FDH should issue Hanford wide NCS policy and develop contract mechanisms to ensure that FDH NCS policies and procedures are binding upon all subcontractors.*

4.1.3 Assignment of Responsibility for Criticality Safety

FINDING: *The responsibilities of the criticality safety engineer are not defined by BWHC Management.*

The Team reviewed FDH HNF-PRO procedures, which are implemented by BWHC and the PFP Manual FSP-PFP-5-8[15]. In addition to using the FDH HNF-PRO documents, BWHC documents the responsibilities and how they are implemented in Manual FSP-PFP-5-8, "PFP Administration – Criticality Safety." The roles and responsibilities of the CSR, line management, Nuclear Safety, and Engineering are clearly defined and documented. The responsibility of the criticality safety engineer is not documented in these manuals. The BWHC criticality safety improvement team developed draft roles and responsibilities for the CSE but this documentation has not been incorporated into the PFP manual.

BWHC Management enlisted the full time services of a FDNW criticality safety engineer in December 1997 in response to a DOE recommendation. Interviews with BWHC Management, the PFP CSR, and FDNW Management revealed that the FDNW CSE did not assume the responsibilities expected by the December DOE review. BWHC Management identified the assignment of the FDNW CSE to the ESH&Q Nuclear Safety organization rather than Engineering as a contributing cause because of the oversight role of this organization at PFP. BWHC subsequently reassigned the CSE to report through the Engineering organization to correct this deficiency.

SUGGESTION. *The Team suggests that BWHC consider reporting the FDNW CSE to the PFP Plant Manager along with the CSR. This will provide additional synergy since the CSR and CSE must work closely together.*

FINDING: *FDH does not define comprehensive responsibilities for the criticality safety engineer according to ANSI/ANS-8.19 in HNF-PRO-334.*

The Team reviewed procedure, HNF-PRO-334, *Criticality Safety General, Requirements*, which defines criticality safety responsibilities for the Hanford site. Responsibilities are listed for subcontractor line management, CSRs, FDH Nuclear Safety, Engineering organizations, Radiological Safety Engineers, Quality Assurance, Transportation and Packaging, and Training. Responsibilities of criticality safety engineers are not listed in HNF-PRO-334. The Team found one set of responsibilities assigned to the CSE in HNF-PRO-539, *Criticality Safety Evaluations,* and allusions to the CSE in HNF-PROs 544, 548, and 549. The Team found the scope of responsibilities too restrictive to ensure safety of operations because it separates the analyst from the operating facility that must implement the controls in the CSER. The responsibilities of the CSE listed in ANSI/ANS-8.19 include review of procedures, equipment designs, modification to processes, investigation of infractions, training operators, and performing audits. The CSE familiar with operations is uniquely qualified to perform these functions by virtue of his thorough understanding of the physics of criticality and the application of criticality safety practices.

CONCERN: *DOE-RL does not provide performance expectations to FDH and monitor the implementation of the PFP criticality safety program with subject matter experts with the necessary frequency and depth to verify performance.*

FINDING: *DOE-RL does not provide criticality safety related performance measures to the contractor as required by the FRAM.*

FINDING: *DOE-RL does not regularly review criticality safety analyses as required by the FRAM.*

FINDING: *DOE-RL does not maintain knowledge of the resource requirements needed for the PFP NCS program as required by DOE Policy.*

DOE-RL does not monitor the PFP criticality safety program with the frequency or depth required to verify performance. The Team reviewed CSER 96-023 for PFP Glovebox HC-21A and found that it did not establish double contingency for the operation. DOE-RL did not review the CSER until the Team brought it to their attention. Facility Representatives assigned to the Assistant Manager for Facility Transition perform routine surveillances and assessments of PFP. The Facility Representatives have criticality safety training commensurate with their responsibilities but not the knowledge of the physics of criticality, codes, regulations, guides, and criticality safety practices needed to assess the overall criticality safety program of PFP. The criticality safety subject matter expert reporting to the DOE-RL Environment Safety and Health organization performs informal reviews of the PFP criticality program. However, neither the ESH SME nor the Facility Representatives regularly review the CSERs that form the PFP authorization basis. The Facility Representatives do not have the background to perform such a review.

According to the Functions, Responsibilities, and Authorities Manual (FRAM)[16], DOE-RL assigns responsibility for the criticality safety program to line management and the Quality, Safety and Health (QSH) organizations. The DOE-RL line organization responsible for PFP is the Transition Programs Division (TPD) reporting to the Assistant Manager for Facility Transition (AMF). The FRAM assigns responsibility to monitor the contractor nuclear criticality safety program to the TPD and Facility Representatives. However, the QSH organization is assigned the task of verifying integration of the Criticality Safety Program into the overall nuclear safety program. While TPD is responsible for assessing contractor implementation of the criticality safety program at PFP, both TPD and QSH are assigned responsibility for developing performance measures.

Interviews with QSH and AMF management and staff revealed that neither the QSH nor the AMF organization maintains knowledge of the resource requirements for the criticality safety program at PFP. As discussed in Section 4.1.1, BWHC has identified $230K in criticality safety tasks for which no funding has been identified. DOE Policy 450.5, Line Environment, Safety and Health Oversight, includes the following statement:

> *"Both DOE and contractor line managers must acquire and maintain sufficient knowledge of program activities in order to make informed decisions on safety resources for these activities. The Department's line managers fulfill their responsibilities in part through line management oversight and have unfettered access to information and facilities in a manner consistent with safety and security requirements."*

The Team found during interviews with DOE-RL QSH and AMF management and staff that performance measures for criticality safety have not been established with FDH as required by the FRAM. DOE-RL is not holding FDH accountable for the Criticality Safety Program. The absence of performance measures and performance assurance programs which do not verify the adequacy of the criticality safety authorization basis or inform management about the resources required for the PFP criticality safety program contributed to the approval and implementation of CSER, 96-023.

RECOMMENDATION: *The Team recommends that BWHC and FDH establish formal responsibilities for the criticality safety engineer incorporating the elements from ANSI/ANS-8.19 for PFP and the Hanford site respectively.*

RECOMMENDATION: *DOE-RL should define roles for and utilize additional criticality safety specialists to provide continuous feedback on the implementation of criticality safety programs. Additionally, DOE-RL should establish a clear focus for criticality safety within the organization with defined roles responsibilities and contractor interfaces. DOE-RL should provide programmatic direction to the subcontractors through the IMC while performing direct oversight of the subcontractors.*

RECOMMENDATION: *DOE-RL establish criticality safety performance measures with FDH. Criticality safety performance measures should be considered for:*

- closing infractions in a timely manner;
- avoiding repeat infractions;
- time spent by the CSE on the floor in the process areas;
- reducing discrepancies between CSERs, CPSs and postings;
- encourage self reporting by Operations, minimizing infractions discovered by oversight groups
- formal training and qualification of the CSEs and CSRs; and,
- attendance of the criticality staff at professional technical conferences.

Criticality safety performances measures should not:

- incentivize or penalize award fee to induce the contractor to have zero infractions, or
- involve time or cost of producing CSER.

Examples of performance measures can be found in Appendix F.

4.1.4 Qualification and Independence of Criticality Safety Staff

The Team interviewed the PFP CSR, alternate CSR, and CSR trainee in addition to reviewing the study guide and qualification standard for criticality safety representative.[17] The Team found that BWHC qualifies CSR through a formal training process which culminates in a final oral board. The qualification process is based on a "card" or standard with associated objectives that clearly defines requirements to the candidate and to personnel asked to judge his or her satisfactory completion. The Team interviewed the CSR in training and found that BWHC is providing facility training equivalent to that for shift technical advisors as well as emergency response training. The CSR is not provided opportunities for continuing professional development in the way of attendance at professional conferences or participation on ANSI/ANS-8 Standards committees.

The BWHC CSR reports directly to the PFP Plant Manager as a result of the December 1997 DOE criticality safety review of PFP. The CSE will report through the Engineering organization rather than the ESH&Q organization. The Team found that this organization is acceptably independent of the line operations groups, Transition Operations and Facility Operations. The lines of authority for the criticality safety staff are independent of these two operating groups and the CSR has direct access to the Plant Manager. In addition, PFP has a second criticality safety engineer supporting the ESH&Q nuclear safety group to provide independent reviews. The latter assignment is the equivalent of halftime or greater.

FINDING: *FDH does not have a plan to ensure that qualified criticality safety staff from FDNW or outside subcontractors is familiar with PFP and will be available to BWHC.*

FDH does not provide site-wide requirements for training, qualification, and facility familiarization for criticality safety engineers or criticality safety representatives in the HNF-PRO procedures or in contracting language. FDH Nuclear Safety is assigned responsibility in HNF-PRO-334 to *ensure a qualified nuclear criticality safety staff, familiar with Project Hanford operating plants and processes and with current developments in nuclear criticality safety standards, guides, and analytical codes, is available to all Project Hanford facilities.* Through interviews with FDH Nuclear Safety management and staff the Team found that there are no resources available to implement this requirement and no program is in place. FDH has established an "exclusivity clause" in contracting language that requires all Hanford facilities to give FDNW rights of first refusal on all criticality safety support tasks. This "exclusivity clause" is scheduled to expire at the end of FY98 at which time facilities may procure criticality safety services from any provider. In the absence of a defined FDH program to ensure only trained, qualified, and experienced CSEs are retained to support PFP, expiration of the "exclusivity clause" would leave PFP vulnerable to obtaining more unsafe CSERs.

CONCERN: *The Team is concerned that FDH does not have a centralized criticality safety function staffed with subject matter experts that define requirements and oversee subcontractor criticality safety programs. FDH Nuclear Safety does not have the requirements defined and the contract language established to assure that only trained, qualified criticality safety engineers familiar with Hanford facilities will be selected. Furthermore, the Team found that FDH Nuclear Safety does not have the resources to define such a program by the end of FY98, when the exclusivity clause with FDNW is scheduled to expire.*

Without this programmatic and contractual infrastructure in place, the quality of criticality safety evaluations, and therefore, the criticality safety of operations cannot be assured. In addition, the graded infraction program will not be an accurate indicator of safety due to inconsistent vendor practices.

The criticality safety staff at FDNW has a wide range of expertise. The independence of the criticality safety staff is well defined. Present plans have a FDNW criticality safety engineer resident in a position supporting BWHC Engineering, which accounts for the bulk of the work. The FDNW line management, of course, is independent of the PFP facility.

FINDING: *The FDNW qualification program for criticality safety engineers is not sufficiently rigorous to assure development of necessary criticality safety expertise.*

The Team interviewed FDNW criticality safety staff and reviewed the training matrix[18] provided by management and found that qualification in neutronics is addressed in detail. While necessary for all criticality safety work, this is not sufficient as the other important areas are covered only in a required reading checklist. Qualification of the CSE by FDNW also has a qualification card/standard based on a combination of a required reading list, time in service, and the organization's evaluation work products. The required reading assignments are not supported by objectives and are verified as a whole with documentation by a single signature. Specific requirements for attendance at off-site courses are not part of the qualification process. The standard for becoming a peer reviewer is the basic required reading checklist plus three years of experience. The Team found that this is not a reliable criterion for qualifying as a technical peer reviewer fundamentally because of the ill-defined nature of the experience required. Interviews with FDNW and BWHC management revealed that one of the FDNW criticality safety engineers assigned to PFP is not qualified to the basic technical standard or familiar with the facility. Under the current management and integration arrangement at Hanford, funding for the professional development activities to meet this criterion is uncertain. The PFP CSR(s), FDH NCS staff, and the FDNW engineers to meet their responsibilities need up-to-date knowledge of the constantly changing standards, guides, and codes as well as other nuclear-industry-wide practices. FDNW is an enterprise company requiring some form of external funding from either FDH or BWHC to properly train its CSEs. FDNW did provide a criticality safety short course once but is not funded for training currently.

SUGGESTION: *The Team recommends that qualification of a new CSR be recognized as a PFP priority for both the incumbent and the plant as a whole. Appropriate mentoring by the incumbent CSR is crucial to the succession and should be facilitated by appropriately shifting some responsibilities from the incumbent CSR to the FDNW CSE. Without proper sharing of responsibilities between the incumbent CSR and the CSE there will be no time for mentoring due to the press of urgent PFP criticality safety tasks.*

RECOMMENDATION: *All BWHC, FDH, and FDNW criticality safety personnel working at or for PFP should have professional development opportunities related to ANSI/ANS-8 standards and other subjects pertaining to their areas of support for PFP work.*

RECOMMENDATION: *In the absence of effective criticality safety programs at DOE-RL and FDH, consideration should be given to extending the exclusivity clause for FDNW because, even with the above programmatic deficiencies noted, several members of the FDNW criticality safety staff have Hanford and PFP experience and the demonstrated technical ability to provide support to PFP. DOE-RL, FDH, and BWHC should form a partnership to ensure that FDNW provides the best CSE support available to PFP in the near term until specific guidance is developed by FDH to provide necessary NCS technical support in the longer term. Alternatively, BWHC could retain its own CSE staff as permanent employees or FDH could assume the NCS role for the site and matrix CSE to the facilities as needed. While the first of these three options fits best with the current IMC arrangements, the third has the best chance of providing a vigorous NCS program for Hanford.*

RECOMMENDATION: *The FDH CSE training and qualification program for PFP should include formal coursework (similar to that at Y-12 and Savannah River), on-the-job training under appropriate NCS mentors, and a formal program of familiarization with facility operations followed by an oral board similar to that used to qualify CSRs. The qualification for peer reviewers should require specific facility related NCS experience and evidence of technical competence and leadership such as technical papers and reports at professional conferences. FDH should ensure funding is provided for CSE training and qualification.*

4.1.5 Monitoring the Effectiveness of the Criticality Safety Program

The Team found that BWHC has a system in place for monitoring the implementation of the criticality safety program at PFP. The major elements are a Nuclear Criticality Improvement Team (CIT), routine assessments performed by operations and the CSR, and routine reviews performed by ESH&Q personnel. BWHC reviews of the criticality safety program begin with the acceptance of the CSER from FDNW. The BWHC self-assessments and audits detect nonconformances with the criticality prevention specifications and postings by operating groups, inconsistencies between the CSER, CPSs, and postings, and deficiencies in programmatic requirements defined by HNF-PRO procedures. BWHC has hired a new manager to upgrade and implement tracking and closure of PFP corrective actions entered into the FDH Deficiency Tracking System. However, BWHC does not perform independent technical reviews of CSERs. The CSR reads and understands the CSERs from an implementation perspective only. The CSR does not have the training or experience as a criticality safety engineer to perform technical peer reviews of the CSER. The Team found that BWHC accepts the CSER at face value for establishing the safety basis for PFP.

FINDING: *FDH does not perform trending of criticality safety infractions and other criticality safety related events.*

FINDING: *FDH does not monitor the criticality safety program with sufficient frequency or depth to assure criticality safety.*

FINDING: *BWHC accepts CSERs from FDNW at face value and does not perform an independent technical review of CSERs prior to authorizing operations as required by ANSI/ANS-8.19.*

HNF-PRO procedures assigns FDH the responsibility to monitor the criticality safety program at Project Hanford. Monitoring activities include biennial evaluations by the FEB, oversight by

M. H. Chew and Associates, review of Occurrence Reports and negligible oversight by the FDH Nuclear Safety staff. FDH Nuclear Safety has no self-assessment program in place to evaluate the FDH criticality safety program and their organization's performance. Trending of non-reportable criticality safety non-conformances, Occurrence Reports, and other criticality safety related events is not performed.

FDH Nuclear Safety personnel develop procedures for the Hanford Site. Assigned responsibilities include: interpreting the procedures; supporting programmatic assessments; providing an overview of CSER; monitoring Occurrence Reports and trends; training CSR annually based on occurrences, identified deficiencies, and other lessons learned; and providing technical guidance to the project directors.

FDH Nuclear Safety is not sufficiently staffed to perform frequent oversight and regular assessments. No assessments have been done for PFP under the IMC contract. The single individual responsible for FDH criticality safety is assigned part-time. The half-time staff of FDH Nuclear Safety is tasked with maintenance and revision of HNF-PRO procedures only. FDH Nuclear Safety staff is not trained and qualified as criticality safety engineers and may only tour PFP once a year or less. FDH Nuclear Safety does not review CSERs. As discussed in Section 4.1.1, FDH does not monitor the criticality safety program with sufficient frequency or depth to assure criticality safety. Both he and his management recognize the need to have a greater presence in the field and in the oversight of the criticality safety program.

The Team found through interviews that FDH has established a system for tracking deficiencies and corrective actions to closure. It is incumbent upon the recipient of the action to enter it into the tracking system. Closure is monitored through regular reports and oversight of line managers. Issues identified by the FEB are reviewed at the next biennial assessment.

A new Deficiency Tracking System (DTS) is being installed to replace the existing Hanford Action Tracking System. Senior management views DTS as capable of providing them with necessary information. However, the managers who must implement DTS have less confidence that the system will help them. The major concern is that it will allow "bean counters" and other administrators to make decisions that should be made only by the managers. DTS should be a management system rather than merely an item tracking tool. Managers should work to assure that DTS is used to improve performance.

RECOMMENDATION. *The Team recommends that FDH management should provide additional resources to Nuclear Safety in the form of two qualified criticality safety engineers familiar with facility operations. Furthermore, FDH Nuclear Safety monitoring and trending for the Criticality Safety Program should be increased to include non-reportable criticality safety occurrences and related events so that appropriate corrective actions may be initiated.*

RECOMMENDATION: *BWHC should obtain the technical expertise needed to perform independent peer reviews of all CSERs provided by a subcontractor. Someone familiar with PFP operations and NCS practices should perform the peer reviews.*

SUGGESTION: *Implementation of the Deficiency Tracking System should be improved. Emphasis should be focused on training and other guidance to ensure that project managers use the DTS as a management system and tool for improving performance rather than allowing it to become an administrative "bean counting" device.*

4.1.6 Participation in Auditing the Effectiveness of the Criticality Safety Program

The Team interviewed BWHC management, members of the CIT, and reviewed products from the CIT. BWHC management is included in the membership of the Nuclear Criticality Safety Improvement Team. The Team found that BWHC participates in auditing the effectiveness of the criticality safety program through the CIT, and the reviews by BWHC ESH&Q personnel.

FINDING: *FDH does not perform self-assessments with sufficient emphasis on the criticality safety program to evaluate the program's effectiveness.*

FDH uses the FEB as the primary means of evaluating the effectiveness of the facility criticality safety programs. Biennial assessments are performed. The approach is rigorous with deficiencies reported and tracked at high levels. The Facility Evaluation Boards may enlist management as an expert if desired. Although these biennial assessments are done well, they lack sufficient frequency and emphasis on the criticality safety program to evaluate the BWHC program's effectiveness and compliance with requirements (See Section 4.1.1 for further discussion). The FEB occasionally reviews the FDH nuclear and criticality programs. FDH management does not participate on review teams or committees performing assessments of subcontractor criticality safety programs. M. H. Chew and Associates is also retained to provide additional oversight focusing on best management practices rather than on regulatory compliance. Although an assessment of criticality safety has not been performed to date, one is scheduled for June 1998.

RECOMMENDATION. *FDH should perform self-assessments of the FDH criticality safety program on a periodic basis. Other sites have implemented biennial or triennial reviews with criticality safety experts independent of the site.*

4.1.7 Management Use of Consultants and Nuclear Criticality Safety Committees

Use of consultants or committees is optional according to ANSI/ANS-8.19. FDH retains FDNW to validate computer codes and provide advice on procedure changes. The Facility Evaluation Board monitors the performance of the PFP facility biennially, including the criticality safety program. The FEB reports the results to the president of FDH and enters the findings into a tracking system for corrective actions. Subject matter experts (SMEs) are retained by the FEB, as required, for assessments. A BWHC Criticality Improvement Team coordinates improvements in the program. The BWHC CIT fulfills the role of a safety committee. Review of past actions taken by this group indicates that their role actually is expanding into that of a more conventional safety committee. Interviews with FDNW management revealed that while management performs internal self-assessments, no outside expertise is utilized and no review committees of any form were mentioned. It is not clear why the use of experienced retired personnel, with proven knowledge of the plant and of the types of fissile materials present at the site, is not more extensive.

SUGGESTION: *BWHC, FDNW, and FDH should use PFP-experienced outside consultants routinely to provide assessments, independent technical reviews, management self-assessments, and advice on the implementation of the criticality safety programs.*

OVERALL ELEMENT FINDINGS

Overall, the Team found that BWHC Management has accepted its responsibilities for the PFP NCS program consistent with industry practice, ANSI/ANS-8.19, and DOE-P-450.5. However, the Team found that FDH Management practices do not demonstrate ownership and participation in the NCS Program required by ANSI/ANS-8.19 and DOE-P-450.5. The reduced staff of the FDH Nuclear Safety organization and the resulting absence of effective monitoring and feedback activities make it impossible for FDH to implement the responsibilities delineated in HNF-PRO-334.

The Team recommends that FDH establish a centralized NCS program function. FDH should have at least two full time, qualified CSEs on staff to carry out the assigned NCS responsibilities. The Team recommends that the centralized FDH NCS program establish monitoring and feedback activities to maintain awareness of the activities of the NCS programs at PFP including the level of BWHC resources needed to maintain the PFP NCS program.

The Team found PFP to be deficient regarding ANSI/ANS-8.19 requirements for formulating NCS policy and assuring all employees involved with fissile material operations are familiar with it. The Team found that both FDH and BWHC do not have concise NCS policies.

The Team recommends that a FDH policy statement pertaining specifically to NCS should be developed to meet the intent of ANSI/ANS- 8.19 and promulgated in the Environment, Safety and Health Policy, HNF-MP-001, Rev. 1, June 23, 1997[19], or an appropriate separate document. In addition, the Team recommends that requirements to conform to FDH NCS policy and procedures be clearly and unequivocally communicated to site contractors, preferably by contract.

The Team found that neither BWHC nor FDH has defined the responsibilities for criticality safety engineers in conformance with ANSI/ANS-8.19. Therefore, this resource is underutilized being relegated to only performing CSERs that results in an overburden on the CSR at PFP.

The Team found that the DOE-RL is not implementing the criticality safety program required to meet the expectations of the FRAM and DOE Policy 450.5. DOE-RL does not perform oversight and monitoring of the contractor with sufficient frequency and depth to verify performance of the NCS program. DOE-RL does not establish criticality safety performance measures with FDH.

4.2 SUPERVISORY RESPONSIBILITIES

The objective of this section was to ensure that supervisors (referred to as "managers" in the BWHC organizations) accept responsibility, maintain trained Operators, and participate in the development of NCS requirements related to operations under their control. ANSI/ANS-8.19 Section 5.0 and ANSI/ANS-8.20 outlines the supervisors responsibilities related to NCS.

RECOMMENDATION. *The Team recommends that FDH and BWHC procedures be modified to require operations supervision participate in developing contingencies for CSERs and that CSERs be reviewed and approved by line supervision.*

Evaluation Criteria for Supervisory Responsibilities

Supervisors implementing the criticality safety program:

- Accept responsibility for the safety of operations under their control
- Are knowledgeable in the aspects of criticality safety relevant to operations under their control
- Can obtain training and assistance from the criticality safety staff, as appropriate
- Provide training and require personnel under their supervision to understand procedures and safety considerations such that they can perform their functions without undue risk
- Develop or participate in development of procedures applicable to operations under their control and maintain these procedures to reflect changes in operations
- Verify compliance with criticality safety specifications for new or modified equipment before its use
- Require conformance with good safety practices, including labeling of fissile materials and good housekeeping

4.2.1 Acceptance of Responsibility for Safety of Operations

FINDING: *The PFP managers do not formally participate in the identification of process upsets (contingencies) that could lead to a potential criticality and do not review and approve CSERs.*

The Team interviewed BWHC Transition Operations supervisors and found that they accept limited responsibility for NCS for their operators and their activities. They rely heavily on the CSR and the CSER process for NCS. They are not familiar with the actual safety basis in the CSER. Operations supervisors are not involved in identifying the process upsets (contingencies) or in assuring that engineered controls are used when feasible. The Assistant Transition Manager did recognize that 15 kg of moderated plutonium in a glovebox would be a matter of concern (as described below in Section 4.5). This indicates that NCS training has imparted appropriate knowledge to these individuals. The functional supervisors approve the Criticality Prevention Specifications (CPS) that contain the information for the criticality safety postings. The PFP plant manager does approve the limits and controls required in the CPS. Operations supervisors do not review or approve CSERs for processes under their control.

4.2.2 Knowledge of NCS Relevant to Operations

FINDING: *Managers are not aware of criticality scenarios (contingencies) or assumptions in the CSER.*

The Team reviewed the criticality safety training courses for managers/engineers[20], fissionable material handlers[21], and the FDH procedure,[22] containing the site wide requirements for criticality safety training. Supervisors take an eight-hour course in NCS as part of their training for PFP activity. Refresher training is provided every two years. In addition, the CSR is available for consultation on criticality safety matters. If the CSR cannot answer an inquiry, then he contacts the FDNW CSE for information. Both the CSR and the FDNW CSE indicated that their contact by phone was quite frequent. The Team interviewed line Transition Operations supervisors and managers at PFP. The supervisors were aware of the need to follow the limits and controls and of the need to convey this requirement to the operators. The functional supervisors do not use the CSER directly, but rather rely on the CPS that the CSR develops from the CSER[23]. As mentioned above, reliance is placed on the FDNW CSE to identify and control contingencies that could lead to a criticality. The supervisors and manages do not participate in the development of contingencies during the development of CSER. Line management does not sign or approve CSERs. This places the burden of understanding the normal and credible abnormal process upsets on the CSR and the FDNW CSE. In addition, line management is not aware of the underlying assumptions and scenarios developed in the CSER which eliminates their ability to monitor process changes relative to these safety bases.

RECOMMENDATION. *Line supervision should review and approve CSERs for operations under their control.*

4.2.3 NCS Training for Personnel

The Team interviewed the BWHC CSRs, training managers, and reviewed training procedures. Training of operations personnel on nuclear criticality safety generally consists of a generic classroom session for Hanford fissile material handlers, job-specific orientation (JSO), and task-specific briefings to each in-plant evolution.

A generic nuclear criticality safety course is conducted by Exitech Hanford for all Hanford fissile material handlers (operators), cognizant health physics technicians, and managers and engineers at the Hanford Training Center. The initial training is eight-hours in length with a nominal "half day" refresher required once every two years. Operators receive the same training as do the managers and engineers, but the focus is slightly different with each group having a few unique learning objectives (and subsequent examination questions). The refresher training covers exactly the same learning objectives, but is streamlined by distributing the course handout in advance to allow for study. The course lesson plan and handout shows good conformance to the ANSI/ANS-8.20 standard.[24]

Job-specific orientation (JSO) provides operators with additional nuclear criticality safety training, although not in a dedicated course. PFP functional supervisors and the CSR provide on-the-job training to operators. Currently, all fissile material handling is done under the plan of the day (POD) and close management supervision.

A number of PFP technical courses and mock-up training activities include attention to use of Criticality Prevention Specifications (CPSs), postings, and work practices. The CSR is actively involved in providing and/or reviewing the technical content of the training. Required records are maintained by the PFP training organization.

Task-specific training appears to be mainly in the form of pre-briefings prior to each in-plant evolution. Team members witnessed a pre-briefing and subsequent conduct of a simple plant evolution – movement of a drum from one location to another in order to alleviate a criticality infraction – by the Transition Operations organization. This was their first evolution following a lengthy stand-down. Participants were the supervisor, three operators, and a health physics technician, as well as the cognizant Senior Supervisory Watch (SSW) and DOE Facility Representative. Each studied in advance the applicable radiation work permits (RWPs), CPSs, and procedures. The supervisor verified proper understanding by each of the requirements for the evolution through oral questioning and discussion. When the pre-job briefing was concluded, the evolution proceeded and was observed to be conducted in a very methodical and professional manner. Although the evolution was simple, the enthusiasm to be back to work was evident. It also was encouraging to be informed that the operators subsequently re-convened of their own volition to discuss the evolution and identify lessons learned that may be applied to future operations.

Figure 1. Drum storage of solution at PFP

SUGGESTION: *The observed evolution—movement of a single drum—was simple and involved only one group of operators in the Transition Operations organization. According to the DOE Facility Representative, this organization has been responsible for the last four PFP stand-downs (one of which was criticality safety relate) and on the earlier occasions has re-started effectively only to lapse later. Management should do what it can to build on and maintain the positive momentum of this particular re-start effort.*

One PFP functional supervisor who was interviewed indirectly (through interactions with the Team during his involvement in the review-group tour and by observation of a pre-job brief) seemed appropriately knowledgeable of the nuclear criticality safety aspects of the operations under his control. Training and assistance are provided routinely by NCS staff in the person of the CSR. (See the description for the next criterion for additional detail.)

SUGGESTION: *As the out-sourcing of the generic NCS training from FDH to Exitech Hanford was less than a month old at the time of this review, management should evaluate course conduct and the Hanford-specific knowledge of the instructor from time to time.*

The Team found that the Exitech Hanford instructors for the generic NCS course are familiar with operations and current criticality safety issues at Hanford. Although the current Exitech instructor is a retiree who had been away from training for about a year-and-a-half, he had experience in several Hanford-site assignments which involved nuclear criticality safety on a day-to-day basis and developed the original lesson plan and other course materials from which the current course evolved. Fortunately, the most recent instructor, who is now the course coordinator for FDH, indicates that event reports and other related current event information is transmitted to the instructor for his use. Exitech Hanford senior management, experienced in training practices of the commercial nuclear reactor industry and its Institute for Nuclear Power Operations (INPO), indicates that they support instructor professional development including required attendance at the FDH annual seminar for CSR and attendance at off-site courses or conferences. Course evaluation forms are provided to the participants at each session. The forms are reviewed by both Exitech and FDH personnel with course changes to be made as appropriate (and as required by the contract).

4.2.4 Development of Procedures

Procedure development is a team effort at PFP. They are drafted by Engineering and validated by Operations. The functional supervisor and two operators validate the new procedure by walking down a draft revision. If revisions are necessary, the walkdowns continue until all revisions have been validated.

SUGGESTION: *Some procedures have been revised very frequently. The root cause(s) for such changes should be identified and resolved.*

One particular procedure, dealing with fissile material handling was revised for administrative or technical reasons in-total at least three times and in-part six additional times in a 15-month period. The procedures contain the NCS limits and controls which are indicated in a highlighted format.

The Team found that the procedures are approved by the CSR to ensure that they contain the appropriate NCS limits and controls. The procedures and CPSs are validated by operations prior to use. The CSR provides surveillance for procedural compliance. All operations procedures are scheduled for a three-year review when they are issued.

The Team toured PFP and found that criticality postings were located appropriately. Storage drums were in designated storage locations and were labeled with contents. However, the postings contained a great detail of information and, as a result, used very small print. This makes the postings seem more like procedures rather than serving to reinforce the limits and controls. Postings should be visible at greater than normal procedure-reading distances. See Section 4.4 for the recommendations concerning procedures and postings.

STRENGTH: *The thorough knowledge of operations and the technical ability of the incumbent CSR is the outstanding feature of the BWHC NCS Program.*

OVERALL ELEMENT FINDINGS

The Team found BWHC line supervision generally meets the expectations of ANSI/ANS-8.19. The strength of BWHC operations is the thorough operations knowledge and technical ability of the CSR. NCS training provided to operators is a strength of the program. The Team found, however, that line supervisors do not participate in the development of CSERs and are not familiar with the criticality safety basis or contingencies.

4.3 NUCLEAR CRITICALITY SAFETY STAFF RESPONSIBILITIES

The objective of this element is to ensure that the NCS responsibilities and functions are providing the bases for an effective criticality safety program. The PFP NCS staff responsibilities are split between the

Evaluation Criteria for Nuclear Criticality Safety Staff Responsibilities

The criticality safety staff:

- Provides technical guidance for design of equipment and processes and for development of operating procedures
- Maintains familiarity with current developments in standards, guides, and codes
- Consults with knowledgeable individuals to obtain technical assistance as needed
- Maintains familiarity with all operations requiring criticality safety controls
- Assists supervisors, on request, in training personnel
- Conducts or participates in audits of criticality safety practices and procedure compliance as directed
- Examines reports of violations and other deficiencies for improvements of safety practices and procedures and reports findings to management

FDNW CSE and the BWHC CSR. This split has the potential for miscommunication and unfulfilled CSE responsibilities because, in the FDH integrating contractor plan, the PFP staff must obtain services from FDNW via task order contracts. ANSI/ANS 8.19 Section 6.0 outlines the requirements for NCS staff.

FINDING. *BWHC does not utilize the FDNW CSE to perform the functions required by ANSI/ANS-8.19. Specifically, the Team found that the FDNW CSE does not review operating procedures, review postings, provide training assistance, perform audits, categorize infractions, or develop infraction corrective action plans to improve safety practices.*

FINDING. *FDNW CSEs assigned to PFP are not familiar with operations or the facility.*

FINDING. *FDH does not require CSEs supporting PFP to be familiar with the facility or operations.*

FINDING. *FDH and BWHC do not have programs to train CSEs to familiarize them with operations and the facility.*

The Team found through interviews and review of the HNF-PRO procedures that the PFP CSR bears the burden of providing all the criticality safety guidance and input for procedures, process modifications, new designs, NCS training for operators, infraction response and corrective actions, and operations audits. The role of the CSE at PFP is limited primarily to providing CSERs via task order. There are no formal defined responsibilities for the CSE in either FDH or BWHC procedures as discussed in Section 4.1 of this report. The CSR function is a one-staff person effort and appears to be understaffed. As a result, the quality of the work has suffered, as demonstrated by the deficiencies between the CPS and postings identified by the CIT. Following the December 1997 DOE Review of PFP, CSEs are now assigned on a part-time basis to support the NCS program at PFP. As the CSE is utilized to perform some of the functions currently carried out solely by the CSR, the quality of the NCS program should improve. The Team learned that the incumbent CSR who was knowledgeable of operations and all the CPSs at PFP intends to vacate the position, in part, due to the high demands and limited career path. The Team regards the loss of a second competent, qualified CSR at PFP within a year to be a significant detriment to the NCS program. Sharing the PFP NCS responsibilities equitably between the CSE and CSR should provide synergy and avoid overburdening either.

Design projects may be conceived before the FDNW CSE staff is involved. The FDNW CSE staff does provide input to the design of new processes, but primarily through interaction with the CSR who initiates the request for a CSER. The most recent example is a vertical calciner that is nearing completion of installation. Currently, PFP conducts mainly glovebox operations using existing equipment.

The BWHC Nuclear Safety function does not provide technical oversight to the NCS program, but it does give management oversight to the program. The Nuclear Safety function confirms that other safety and operating groups complete their assigned functions in a timely manner. There are plans to add a part time FDNW CSE to the staff. The CSEs will be used to provide the technical oversight that has been missing in the past. The part-time CSE will be tasked with resolving NCS posting issues, updating old (20 years) CSER, and similar duties. The FDNW CSE selected is computer code qualified, but is not facility qualified.

The staff at FDNW has little familiarity with PFP operations. Some of the CSEs, qualified consistent with the internal FDNW program as analysts and peer reviewers, have essentially no PFP experience. Such experience is not a prerequisite for working on PFP CSERs. Recent initiatives to have FDNW CSEs in residence at PFP, on a full-time basis, will provide opportunities for the FDNW CSE to gain the needed familiarity with PFP operations. However, the Team found that FDH and BWHC do not provide structured training programs to familiarize the CSEs with the facility and operations.

Figure 3. Fissile material operations being conducted in glovebox HC-21A

Furthermore, FDH and BWHC do not require such familiarity to provide NCS support to PFP.

Budget constraints adversely impact FDNW attendance at professional meetings, availability of codes, and professional development activities for the NCS staff. The FDNW NCS staff is represented at professional technical meetings and is capable of running several Monte Carlo codes for criticality safety calculations. One of the codes is being retired because of the annual licensing fee but the staff still has access to two other codes (MCNP and KENO). Budgets are very limited and place restraints on travel to technical meetings. The Team interviewed one FDNW CSE who does not believe that the ANSI/ANS-8 series standards are relevant to the organization's work. These standards are the industry-accepted guidance for criticality safety and form the bases for DOE Order 5480.24. The deficiencies in the training and qualification program for CSEs were discussed in Section 4.1 of this report.

The Team learned through interviews with FDH, BWHC, and FDNW management that NCS experts independent of Hanford are not utilized to perform assessments or provide mentoring. External technical assistance has not been used because a technical need has not been identified by any of the NCS staff at Hanford. Such assistance could be obtained, if needed. The Team believes that use of independent NCS experts to perform program assessments and mentoring would have identified many of the deficiencies described in this report. The Team has discussed the use of external assessments and criticality safety committees in Section 4.1 of this report.

BWHC implemented a graded infraction reporting system in response to the December 1997 DOE review. The Team found through interviews with the CSR that some information is exchanged between the CSR and the FDNW CSE when a criticality infraction is discovered, but this is informal. The PFP staff is currently revising the infraction reporting system. The graded infraction program relies upon unambiguous identification of contingencies for proper categorization of the infraction. The team found the current terminology for infraction reporting is unusual and confusing in that controls are credited as contingencies in the CSER (see Section 4.5.1). Until the CSERs can be revised to correct this deficiency, the CSE should be required to provide technical advice to management regarding the severity of the infraction and which contingencies remain uncompromised.

OVERALL ELEMENT FINDINGS

The Team found that the BWHC NCS program is deficient in the utilization of the FDNW CSE with respect to the expectations of ANSI/ANS-8.19. The under-utilization of the CSE has placed too much burden on the sole CSR with the result that numerous discrepancies between CPS and postings have resulted and the CSR is no longer a desirable position with the organization. Furthermore, the Team found that there are no mechanisms in place to ensure that CSEs providing services to PFP are familiar with the facility and its operations.

RECOMMENDATION. *Some of the NCS responsibilities currently assigned to the CSR should be transferred to the FDNW CSE supporting PFP. Among these responsibilities are reviewing operating procedures and postings, process and equipment modifications, assisting with NCS training, performing regular audits, and evaluating infractions and developing corrective actions.*

RECOMMENDATION. *FDH should implement a facility and process orientation training requirement for CSEs and require that engineers so qualified produce all CSERs provided to PFP. CSEs in training could do much of the analytical work for a CSER under the close supervision and mentoring of a qualified CSE who would formally issue the CSER. In the near term, FDH, BWHC, and FDNW should ensure that only CSEs familiar with the facility and operations provide support to PFP until the facility training program is in place.*

RECOMMENDATION. *The FDNW CSE should be involved in the evaluation of all criticality safety infractions, development of corrective actions, and issue reports to both BWHC and FDH management. This input is essential to prevent under-reporting of criticality safety infractions due to improperly crediting controls as contingencies. (See Section 4.5).*

4.4 OPERATING PROCEDURES

The objective of this element is to ensure that procedures and postings are effective in communicating the NCS requirements to personnel and that deviations are handled appropriately. The PFP operating procedures, supplemented by NCS postings for the limits and controls that can be manipulated by operators, are intended to control operator actions so as to keep activities with fissile material within the evaluated safety bases. The procedures are developed by PFP engineering and validated by operations. The CSER limits and controls are to be incorporated into the PFP operating procedures. ANSI/ANS 8.19 Section 7.0 outlines the requirements for procedures related to criticality safety.

Evaluation Criteria for Operating Procedures

- Criticality safety procedures:
  - Are organized and presented for convenient use by operators and are free of extraneous material
  - Include controls and limits significant to criticality safety of the operation
  - Are supplemented and revised as improvements become desirable
  - Are reviewed periodically by supervision
  - Are reviewed by criticality safety staff before issuance or revision
  - Are supplemented by posted criticality safety limits or incorporated in checklists or flow sheets
- Deviations from procedures and unforeseen changes in process conditions affecting criticality safety are documented, reported, and investigated promptly and actions taken to prevent recurrence
- Operations are reviewed frequently to ascertain that procedures are followed and that process conditions have not changed so as to affect the criticality safety evaluation

4.4.1 Procedures Facilitate the Safe and Efficient Conduct of Operations and Include NCS Controls and Limits

Review of PFP operating procedures indicated that they are written so that operators can proceed in a stepwise fashion through the specified operation. NCS limits and other cautions are highlighted in the procedures. Only the limits and condition for operation that are subject to operator control are in the procedures. Engineered controls that the operators do not manipulate are not placed in the procedures. See further information contained in Section 4.2.4.

FINDING: *BWHC operating procedures change frequently and rapidly such that affected groups may not be aware of the changes.*

The Team reviewed operating procedures and found that the procedures can be changed so rapidly that the changes appear from one shift to the next. Under such conditions it is possible for one operating group to make changes that adversely affect another group because the changes are not well coordinated. The Transition Assistant Manager is working to reduce the number of separate organizational procedures by moving to having PFP-wide procedures for all common activities (e.g., packaging, transport, and sampling). A Procedure Change Board should be considered to improve the quality of the procedure changes and minimize the impact on training of operators.

RECOMMENDATION. *A BWHC Procedure Change Board should be considered to improve the quality of the procedure changes and minimize the impact on training of operators.*

Accessibility to procedures in work areas was good. During a plant tour, the CPS and operating procedures near or at work consoles and the placarded symbol from the pre-fire plan in doorways and hallways were observed.

The pre-fire plan is used by the CSE in preparing CSER. Knowing how the potential fires will be suppressed allows the CSE to use more realistic scenarios for off-normal conditions. As an example, direct steam fire nozzles are not used. Mist and fog nozzles are used. This allows the CSE to make realistic assumptions about movement of units in a glovebox and the flooding of a glovebox. This is not totally without risk because the HFD can use any means necessary to fight the fire (just as was done at Rocky Flats to save the facility in the 1960s)[25]. The PFP Fire Safety Engineer initiates a Fire Risk Assessment and a Fire Hazards Analysis. With this information, the Fire Marshal at HFD, who receives his charter directly from DOE, develops a Pre-Fire-Plan. This plan is used to train the fire fighters and to develop the procedures for fire fighting.

Every room and hallway in the PFP facility has a placard with a symbol designating the preferred fire fighting method. The fire fighters are trained to use this placard code upon entry into the facility. All of the pre-fire plan information is also summarized and computerized in the command vehicle[26].

The Team found two strengths related to the Hanford Fire Department (HFD) program and procedures.

Strengths

- The HFD and PFP have a fire safety program, including procedures[27] that impact on PFP in a direct and positive manner.
- The availability of operating procedures and the room placards with fire suppression codes from the pre-fire plan are program strengths.

4.4.2 Procedure Review

Operating procedures are scheduled for review by operating supervision every three years. Complete revisions often occur earlier so that this three-year requirement is not a significant burden. The BWHC CSR reviews new or revised operating procedures. The CSR is responsible for ensuring that the operating procedure is in agreement with the CPS that has been approved by the FDNW CSE. The FDNW CSE does not participate in the establishment of procedures or in the periodic review of procedures. The CSE is considered to be the technical expert on NCS requirements and the CSR works to implement the requirements in part through the procedures. The tracking mechanism to assure that procedures are reviewed in a timely manner was not part of this review.

SUGGESTION: *The FDNW CSE assigned to the BWHC engineering group should participate in the approval of operating procedures to ensure that all limits and controls are correctly transferred into the procedures. (See Section 4.3 for Findings and Recommendations on NCS Staff Responsibilities.)*

4.4.3 NCS Postings

There are problems with accuracy of the postings (identified by the CIT[28]) and with the amount of information squeezed on to the postings (human factors issues). Some immediate corrective actions have been initiated by BWHC to resolve the discrepancies between postings and CPS. The three-year requirement for procedure review is not applied to postings since they are not considered procedures by BWHC.

FINDING. *Criticality safety postings do not incorporate good human factors practices.*

The observed postings appeared to contain the necessary and sufficient information on limits and controls that could be manipulated by operators. The postings that were observed provided most of the information in a manner that did not require interpretation. However, some of the information had to be interpreted, e.g., the correct mass limit had to be selectively chosen from several limits, depending on the amount of moderation. It would have been more clear if there had been a one to one correspondence between the mass limit and degree of moderation. The team observed that some postings were cluttered with information and contained information common to criticality safety engineers but not operators. For example, Figure 2 shows the criticality safety posting for room/corridor storage and transportation. The posting contains array definitions that have meaning to the NCS staff but not necessarily to operators. Rather than stating the array is limited to an "infinite by infinite" array, other sites have utilized the term, "one layer planar array".

CRITICALITY SAFETY POSTING

ROOM/CORRIDOR: STORAGE AND TRANSPORTATION

CONTAINER	H/X RATIO LIMIT	MASS LIMIT GRAMS (PU, ^{235}U)	STORAGE ARRAY SIZE LIMIT
5-LB SLIP LID CAN, 6-IN.DIA. (UNMEASURED GLOVEBOX SOFT WASTE PRODUCTS)	UNRESTRICTED	2500 3 KG NET WEIGHT FOR CAN CONTENTS	FOR TRANSPORT TO AND FROM NDA ONLY
50-LB LARD CAN	= OR < 20 UNRESTRICTED	400 100	∞ X ∞ X 4 TIERS ∞ X ∞ X 1 TIER
55 GALLON DRUM	UNRESTRICTED	250	∞ X ∞ X 1 TIER
DOT-6M, AL-M6, COC #9965, 9966, 9967, 9968	= or < 2 = or < 7	4500 4400	∞ X ∞ X 1 TIER ∞ X ∞ X 1 TIER
M-101/102, ROD BIRDCAGE	= OR < 20	4500	40 X 40 X 1 TIER
A-BIRDCAGE	UNRESTRICTED = OR < 20	100 4500	∞ X ∞ X 1 TIER 40 X 40 X 1 TIER
L-10, 10L, FL-10	UNRESTRICTED = OR < 20	4500 4500	∞ X ∞ X 1 TIER 40 X 40 X 1 TIER
PR CANS - STANDARD, EMERGENCY, MK-V	UNRESTRICTED	4500	∞ X ∞ X 1 TIER
MK-IV PR CAN	UNRESTRICTED	4500	175 X 1 TIER
ISOLATED TRANSPORT CONTAINER	(SEE POSTING ON CONTAINER)		
FIXED ARRAY WAGON	(SEE POSTING ON WAGON)		

STORAGE SPACING LIMITS	TRANSPORTATION SPACING LIMIT
3 FEET (MINIMUM) BETWEEN TWO STORAGE ARRAYS OR AN ARRAY AND MORE THAN 100 GRAMS OF FISSILE MATERIAL (INCLUDING THROUGH NON-ISOLATING WALLS)	18-INCHES (MINIMUM) FROM OTHER FISSILE MATERIAL

REFERENCE: CPS-Z-165-80100, 80110, 80116 Control No. 4/92 Rev. 0

Prepared by: PFP CSR Date Approved by: PFP Safety Assurance Date

Reviewed by: PFP Engineering Date Approved by: Manager, PFP Operations Date

Approved by: Manager, Safeguards HC Date Approved by: Manager, Env. Waste Ops. Date

Figure 2. Example of cluttered Criticality Safety Posting for storage and Transportation at PFP

RECOMMENDATION: *Criticality safety postings should incorporate good human factors practices. Procedures for developing postings have been implemented at Rocky Flats, Y-12, and BWX (formerly Naval Nuclear Fuels Division [NNFD]). The CSE should approve the postings to ensure that all limits and controls are correctly represented.*

FINDING: *BWHC does not provide an independent validation by the FDNW CSE that the correct limits extracted from the CPSs are included on postings.*

The Team found through interviews and reviews of HNF-PRO-334 that the FDNW CSE does not review or concur on postings. Furthermore, there is no procedure for selecting which controls from the CPS are transferred to the procedure and which are transferred to postings. Therefore, the team found that there is no oversight to ensure that the CSR posts the correct limits on the postings or that changes to the postings are correct.

First line managers and operators tour the facility every month to verify process conditions still match CPSs. Corrective actions are initiated as needed.

SUGGESTION: *BWHC should consider performing a root cause analysis for the discrepancies between the CPSs and postings found by the CIT and implement a corrective action program derived from its conclusions.*

4.4.4 Documenting, Reporting and Investigation of Deviations from Procedures

Anyone detecting a deviation stops work and notifies the CSR and line manager. The CSR and line manager make the determination to correct the deviation immediately or to post the area if an infraction is suspected. The CSR may consult the FDNW CSE for guidance in making the interpretation. The FDNW CSE does not have involvement in response to an infraction. The CSR and line management prepare and implement a corrective action plan to return to operation.

The deviations from procedure are reported to management promptly. The program to categorize the incidents is being revised. The historical tracking system for corrective actions has not functioned well, but now is receiving PFP attention. Corrective actions are either not taken promptly or the corrective actions are not documented promptly. (See Section 4.1.5 for a discussion on the Deficiency Tracking System.)

FINDING. *The BWHC graded infraction program categorizes infractions based on contingencies which are improperly identified in existing CSERs.*

The Team reviewed CSERs supporting Phase 2 operations, the BWHC graded infraction program, and internal reports of the response to infractions. The Team found (see Section 4.5) that the CSERs improperly identify controls as contingencies. The graded infraction program implemented at PFP is similar to those successfully implemented at other sites such as Rocky Flats, Y-12, and LANL. The graded infraction program reporting criteria depend upon the contingencies developed in the CSER. At PFP this could result in under-reporting of criticality safety infractions since the number of controls always exceeds the number of contingencies for a given operation. The Team recommended in Section 4.3 that a FDNW CSE should be involved in evaluating infractions, developing corrective actions and providing reports to management. Implementing this recommendation in the near term will help reduce the chance of under-reporting. However, a more structured approach to identifying contingencies and categorizing infraction is needed until the CSERs can be reviewed and revised as necessary. See Section 4.5 for a recommended structured approach in the near term using the Criticality Safety Limit Examination Program.

OVERALL ELEMENT FINDINGS

Overall the Team found well prepared BWHC operating procedures that were easily accessible to the operators and contained NCS limits and controls. The missing link in this element is that the FDNW CSE does not participate in the review and approval of postings and procedures. The Team recommends that the CIT identified discrepancies related to CPS and postings be corrected and that good human factors practices be incorporated into future postings.

The graded infraction program may result in incorrect categorization due to confusion of controls versus contingencies in the CSERs. The Team recommends that the FDNW CSE be involved in the categorization in the near term until all CSERs can be reviewed and revised.

4.5 PROCESS EVALUATION FOR NUCLEAR CRITICALITY SAFETY

The objective of this element is to ensure that proper NCS evaluations are being produced. At the PFP, process evaluations to establish an NCS basis are known as CSER. The BWHC CSR, acting for operations management, initiates the request for development of a CSER. The CSR writes a proposed process description which is transmitted to FDNW for cost evaluation. If the budget allows, the CSER is then contracted by BWHC via task order with FDNW. After development of the CSER, the CSR performs the follow-on activities such as training, procedure approval, CSER interpretation, and surveillance.

The potential for miscommunication is great at the interface between BWHC and FDNW because of the contract relationship between the two companies. Normally (and previously at Hanford) the CSR and CSE would work for the same company. BWHC buys documents (CSERs) from FDNW on a task order basis, but may not buy "safety" when the CSE are not familiar with PFP. The two companies do concur on a CPS that becomes the controlling document for BWHC. The CSE do not ensure implementation of limits and controls or resolution of infractions, nor do they oversee the overall rigor of the program. BWHC contracts with FDNW to modify existing CSERs rather than to create new evaluations to the extent possible to minimize costs.

Evaluation Criteria for Process Evaluation for Nuclear Criticality Safety

Criticality safety evaluations:

- Are performed before starting new or revised operations
- Determine and explicitly identify the controlled parameters and limits upon which safety depends
- Are documented in sufficient detail and clarity to allow independent judgment of results
- Are independently assessed to confirm the adequacy of the evaluation before use

ANSI/ANS 8.19 Section 8.0, and ANSI/ANS-8.1, outlines the criteria for preparing an NCS evaluation.

CONCERN. *FDNW does not demonstrate the capability to develop PFP CSERs that correctly identify contingencies and assure that operations will remain subcritical under all normal and credible abnormal events.*

FINDING: *BWHC does not have a document control system in place to differentiate draft and approved CSERs.*

FINDING: *The Team found that CSER 96-023*[4] *does not provide a safety basis for moderated plutonium compounds in the glovebox.*

FINDING: *NCS evaluations do not appropriately determine and identify the controlled parameters and their associated limits upon which NCS depends.*

FINDING: *The NCS program does not place adequate emphasis on use of engineered controls for NCS.*

FINDING: *The methodology for identifying scenarios identified as contingencies non-conservatively credits controls and may cause infractions to be categorized incorrectly. FDNW does not differentiate controlled parameters and contingencies.*

The Team reviewed CSER-96-023 for glovebox HC-21A. The CSER allowed either 1) not more than 7.5 kg of Pu metal or 2) not more than 15 kg of moderated plutonium compounds in one glovebox. Plutonium is transferred into the glovebox and then into muffle furnace trays. The loaded trays are sent to muffle furnaces for calcining. The trays of calcined material are brought back into the original glovebox for sampling and transfer to storage containers.

The CSER evaluator apparently focused on limits and controls for 1) transferring the metal feed material into trays for subsequent transfer to the muffle furnace glovebox and 2) processing the calcined material upon its return from the muffle furnace glovebox. The CSER evaluator did not focus on limits and controls for bringing moderated material into the glovebox. There is stated a limitation on the amount of moderator in the plutonium material matrix in the evaluation section of the CSER, but this limit did not get carried forward into the summary section entitled “Design Features and Administratively Controlled Limits and Requirements.” Moreover the containers could be made of polyethylene, which would defeat the moderator limit used in the evaluation. The number of containers that can be placed on the glovebox floor is not limited by the CSER. Spacing between the containers in this group is not required. The volume of the containers, but not their shape, is limited in the CSER. In effect, this CSER authorizes 15 kg of potentially optimally moderated Pu compounds in a glovebox, which under credible conditions could be **critical**. NOTE: Some safety basis problems in this CSER, e.g., control of moderation, may stem from a superseded CSER. See Appendix E for specific deficiencies related to CSER-96-023.

The results of evaluations for both normal and abnormal conditions are displayed together in a single table making it impossible to distinguish between them. Some of the conditions subject to evaluation consider less than a fully loaded glovebox so that at least some of the evaluations are non-conservative. The FDNW qualified Peer Reviewer did not identify the deficiencies in the CSER, nor did BWHC Operations Management or the CSR. It was only after lengthy discussions with the FDNW qualified Peer Reviewer that the flawed safety basis was acknowledged. Fortunately, this CSER has not been used because of the stand-down in applicable operations.

Many contingency scenarios are actually duplicates. In CSER-96-023, for example, Section 8 identifies three contingencies dealing with moderator. They are a) H/Pu> 2, b) introduction of water into the glovebox, and c) water ingress due to fire. These redundant initiators of the same scenario are of concern in wasting expensive resources and, more importantly, in being potentially misleading in evaluation of incidents as possible infractions. In the current infraction identification process, the number of controls remaining after an incident is counted and, if the number is sufficient, no infraction is deemed to have occurred. As mentioned elsewhere in this report, qualitative fault trees should be developed both to foster understanding of the safety basis and to assist in evaluating incidents as potential infractions that require regulatory reporting.

The Team lost a great deal of effort because, more than a week before the review, it was provided an unapproved draft CSER for review. The document was not identified as a draft until Wednesday of the review. The Draft, not marked as such, was assumed to be the effective CSER by BWHC, DOE-RL, and the review team. The lack of signatures was attributed to the document being an electronic copy.

As discussed above, CSER-96-023, did not identify the NCS limits and controls for all of the material authorized for the muffle furnace support glovebox. This could be due to a process description that failed to include the inflow of moderated material. This CSER also uses the word "dry" to indicate restriction on moderator in the glovebox. This is a poor choice of words because it implies limits on the use of liquid moderators, but not on solid moderators such as plastic.

The CSER 96-013[29] for the cementation process glovebox authorizes use of an unfavorable geometry five-gallon container. The NCS control for the container is an in-line filter that, according to the CSER, would "probably" work. The filter system apparently was not tested to ensure performance. More importantly, an operations manager and operator said that the five-gallon container could be replaced with a favorable geometry tank that would not require any in-line filter. The CSERs for all three gloveboxes required spacing between units or groups of units. Apparently physical spacers were not considered as requirements for any glovebox. This demonstrates the lack of emphasis on the use of engineered controls for NCS in the FDH NCS program.

The evaluations generally provided enough information to allow independent review of the safety analysis. The CSER could be improved by use of material flow charts and array configurations for normal and off-normal conditions. The results of the evaluations for normal and off-normal conditions should be presented separately. Only limits used in the CSER should be presented in the same table, e.g., do not alternately mix volume and mass units.

Independent assessments are performed for each CSER. Statements of the assessor's actions are

Figure 4. Glovebox HC-21A at PFP

attached to each CSER. The checklist of actions is used to help provide a complete review. The checklist does not require assessment against the hierarchy of NCS controls (i.e., with geometry first) recommended in both the ANSI/ANS-8.1 Standard and in DOE Order 5480.24.

BWHC informed the Team that it has plans to review all CSERs in a manner similar to a Criticality Safety Limit Evaluation Program (CSLEP) done at RFETS. At RFETS, the CSLEP was used effectively to determine whether historical limits and controls were still valid for current operations and to assure that in the professional judgment of a senior CSE, that the safety evaluation satisfied the double contingency principle. The problems at PFP are different than at RFETS, but the general CSLEP approach can be applied.

The PFP NCS program is being upgraded to better classify incidents and improve the reporting of incidents. The alternate CSR is developing an incident evaluation technique using qualitative fault trees until CSLEP can be completed. With such fault trees available at the time of an incident, it will be straightforward to determine whether the incident is reportable as an infraction.

RECOMMENDATION: *FDNW should review and revise, as necessary, all Phase II CSER. BWHC should have an independent CSE audit each CSER prior to use in Phase II. If the independent audit reveals further deficiencies, then all PFP CSER should be independently reviewed prior to use.*

RECOMMENDATION: *Material flow charts and sketches of normal and non-normal fissile material configurations should be incorporated into the CSERs.*

RECOMMENDATION: *FDH and FDNW should review the Rocky Flats criticality safety evaluation* *procedure for documenting controls and contingencies.*

RECOMMENDATION: *Better document control practices (e.g. marking drafts as "Draft") should be implemented to identify draft CSER documents.*

RECOMMENDATION: *The independent CSER assessment checklist should include a requirement to assess the hierarchy of NCS controls according to ANSI/ANS-8 standards. Justification for selection of administrative controls instead of engineered controls should be required.*

RECOMMENDATION: *Qualitative fault trees should be developed during the CSLEP program. This can serve to proof test the older CSERs for adequate coverage of contingencies and then would be useful in evaluating incidents for infraction reporting. The CSLEP program should be carried out with a CSE familiar with PFP operations.*

OVERALL ELEMENT FINDINGS

The Team found that CSER-96-023 does not provide a safety basis for the glovebox. Furthermore, this CSER was peer reviewed by two qualified FDNW peer reviewers. The NCS program at PFP is not capable of finding and correcting deficiencies in CSERs. The presence of a CSER which, if implemented as written, could lead to a criticality indicates that FDNW may not be capable of producing CSERs that implement double contingency. The Team found that FDNW and BWHC do not emphasize the use of engineered controls over administrative controls. The Team also discovered that controls are mistakenly credited as contingencies by FDNW. Therefore, the Team concludes that the PFP NCS program is severely deficient with respect to criticality safety evaluations according to the criteria of ANSI/ANS-8.19.

4.6 MATERIALS CONTROL

The objective of this element is to address proper movement, labeling and storage of fissile material. ANSI/ANS 8.19 Section 9.0, ANSI/ANS-8.5, *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material,* ANSI/ANS-8.7, *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials,* and ANSI/ANS-8.21, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors,* outline the requirements for appropriate control of fissile material.

Evaluation Criteria for Materials Control

- Fissile material movements are controlled
- Appropriate labeling and postings are maintained to identify materials and limits on parameters controlled by procedure
- Controls on neutron absorbing materials in process materials or equipment maintain the intended distribution and concentration of those materials
- Access to fissile material areas is controlled
- Spacing, mass, density, and geometry of fissile materials are controlled to assure subcriticality

Procedures are implemented for movement of fissile material in and between material balance areas. BWHC Operations personnel physically handle the material. Material balance check sheets are used to maintain a running log of glovebox inventory. BWHC Material Balance Area (MBA) Custodians monitor the material and record all of the transfer information. Under contract to FDH, B&W Protec personnel oversee the work of the MBA Custodians. Procedures for the operations personnel have criticality safety warning notes. The administrative procedures used by the Protec personnel have, consistent with their needs, little or no guidance regarding criticality safety.

Material controls were discussed with PFP personnel. Based solely on these interviews, the team found that solid and liquid waste transfers are controlled by BWHC procedures[30] that include criticality safety limits. It has been several years since shipping anything other than small quantities of solids or laboratory wastes. The Solid Waste coordinator is notified prior to seal-out of the gram-estimated waste from a glovebox. Non-destructive assay is performed after the drum or standard waste box is sealed. Container moves are coordinated with operations. PFP Phase II is a startup of the Vertical Denitration Calciner which will generate about 100 liters/day of liquid waste. Procedures exist for transfer of liquid waste from Tank D8 to Tank D5, and transfer to the tank farm. The receiving organization has a formal process to accept the transfer of the liquid prior to the actual transfer operation. Transfer is done using double-key operation.

During a tour of the facility, material labels were examined and container labeling appeared to be appropriate. Furthermore, access to material storage areas was appropriately controlled.

The Team interviewed B&W Protec staff and concluded that appropriate procedures such as HNF-PRO-502 for accountability, were in place. Daily surveillances are performed during processing; weekly surveillances are performed when not processing. Transfers within MBA are controlled with Glovebox Inventory Forms. Nuclear Material Inventory Transfer forms are used when moving material between MBAs. B&W Protec oversees the activities of the BWHC MBA custodians. According to the Manager of B&W Protec, ownership of the Nuclear Material Control and Accountability Plan belongs to B&W Protec. PFP organizations write operations procedures that conform to plan requirements.

OVERALL ELEMENT FINDINGS

In general, the Team found procedures and labeling were in place to control movement, transfers and storage of materials at PFP.

4.7 PLANNED RESPONSE TO NUCLEAR CRITICALITY ACCIDENTS

The objective of this element is to evaluate PFP emergency plans and procedures and the Criticality Alarm System placement and maintenance process. ANSI/ANS 8.19 Section 10.0 outlines the requirements for emergency response and invokes ANSI/ANS 8.3 for CAS criteria.

Dyncorp has emergency preparedness responsibility for Hanford site-wide and has developed the requisite procedures and interfaces. The CSR has provided appropriate assistance for NCS-specific issues. Emergency procedures for criticality-related events require the presence of cognizant personnel and re-entry requirements. The PFP Facility Emergency Plan includes evacuation routes and assembly stations. Both were clearly marked with the former including green doors indicating exits. Emergency procedures were covered in pre-job briefs. As visitors to PFP, the Team was briefed via a 15 minute video tape on emergency signals, procedures, and assembly points.

Evaluation Criteria for Planned Response to Nuclear Criticality Accidents

- Criticality accident alarm system installations conform with ANSI/ANS guidance on sensitivity, coverage, audibility, and reliability
- Emergency procedures are prepared and approved
- Appropriate evacuation routes are designated clearly
- Personnel assembly stations are designated and means for accountability are established
- Personnel are trained in evacuation methods and routes
- Provisions are made for evacuation of transient personnel
- Drills are performed at least annually
- Pre-arrangements are made for the care and treatment of injured and exposed persons
- Planning includes provisions for identifying exposed individuals
- Instrumentation and procedures are provided for determining the radiation at the assembly area and in the evacuated area
- Emergency procedures address re-entry and response teams

The PFP Operational Safety Requirement (OSR)[31] requires an annual calibration of the CAS. This activity was performed by Instrument Technicians and Radiation Control Technicians (RCTs) to an approved procedure[32] with user-friendly datasheets for documentation. There are seven Instrument Technicians trained and qualified to perform the calibration of the CAS. Retraining is required on a two-year interval and is accomplished by On-the-Job performance criteria at a mock-up of a Criticality Alarm Panel (CAP). The procedure used to complete the calibration is color-coded yellow indicating an OSR system and requires appropriate notifications and approvals for acceptance of system operability.

4.7.1 Criticality Evacuation Drills and Training

Criticality evacuation drills are conducted annually with the CSR and the FDNW Criticality staff responding only upon request. They are not part of the identified facility emergency response personnel and therefore, do not receive the emergency response training. Fortunately, both the designated and alternate CSR have received emergency director training. Because each has found it to be valuable, consideration is being given to adding the requirement to the CSR qualification card.[33]

The Team observed emergency drill preparation activities (for a seismic event scenario). The new Emergency Planning Coordinator, along with his predecessor and four other PFP technical staff members, led the preparation. The Shift Manager acts as the Building Emergency Director (BED) and directs activities from a primary or secondary incident command center. Both centers are equipped with the necessary equipment and documents. The Team found the exercise preparation demonstrated proper planning and conduct which was conscientious, thorough, and focused on self-improvement.

In addition to the required annual evacuation drill, local and facility-wide drills are performed frequently. After each drill, a formal critique is conducted that includes all participants.[34]

4.7.2 CAS Placement and Evacuation Route Documentation

FDNW criticality safety personnel indicated that there had not been any CAS placement for the Hanford facilities since the original installations and that there was not an established methodology for completing such an evaluation. The historic documentation for current CAS coverage at PFP dates back to 1985. Some modifications were made in 1991. The documentation includes identification of areas where the minimum accident of concern could occur. The CSR maintains these documents.

FINDING: *BWHC and FDH do not use a formal process for evaluating fixed or temporary CAS placement.*

The Team interviewed BWHC Engineering staff and found that PFP has both permanent and temporary criticality alarm systems (TCAS). PFP has approximately 46 CAS sets each consisting of three detector heads and rate-meter modules. An evacuation alarm is initiated if 2 of 3 detectors indicate high radiation levels. Warning beacons are present in high-noise areas as identified by operations and shown on drawings. The eight CAP providing service for the 234-5Z Building at PFP are inter-tied such that if any two panels initiate an alarm, all will alarm. Based on the documentation including "essential drawings" reviewed, the CAS coverage for PFP is adequate. Temporary Criticality Alarm Systems (TCAS) may be used in instances where additional CAS coverage is requested or during maintenance of one of the three detector sets.

The Team found that the approval of the TCAS placement is left to the CSR, without any guidance as to how to make these approvals. A formal process does not exist for evaluating fixed or temporary alarm placement at any level. According to PFP personnel, FDNW would be contracted to perform such calculations. (It may be noted that FDNW currently is providing such support to Rocky Flats). The calculational methodology either would be that required by the client or left up to the CSE assigned the work.

OVERALL ELEMENT FINDINGS

RECOMMENDATION. *It is recommended that FDH provide a methodology for evaluating CAS placement and evacuation routes for the Hanford site. Such guidance already has been implemented at Rocky Flats (with the support of FDNW staff) and should be reviewed for applicability at Hanford.*

SUGGESTION: *The Team was informed that the CSR and FDNW criticality staff were not required to receive emergency response training. The CSR and FDNW CSE should be encouraged to participate in emergency response training.*

ANSI/ANS 8.3, section 4.2 requires evaluation of CAS coverage and section 5.8 gives guidance on spacing of detectors. ANSI/ANS 8.19 section 10.3 requires evacuation routes be evaluated "to avoid areas of higher risk". Additionally, ANSI/ANS-8.23, "Nuclear Criticality Accident Emergency Planning & Response"[35] has been approved and will be issued soon. Its provisions are much more detailed than the ones in ANSI/ANS-8.19. A comparison of current PFP practices to the standard, following its issuance, is encouraged.

5. CONCLUSIONS

The Team performed a comprehensive, in depth review of the criticality safety program at PFP as they relate to the operations included in the Phase 2 restart plan. This review established the status of the BWHC program relative to the expectations of ANSI/ANS-8.19 and included effects of interactions with DOE-RL, FDH, FDNW, Dyncorp, and Exitech Hanford. Specific Concerns, Findings, Observations and Recommendations were detailed in Chapter 4, "Technical Review" and summarized in Appendix C.

The Team is concerned about the ability of FDNW specifically, and sub-contractors in general, to provide quality services to PFP, especially CSERs. The Team found an approved and implemented CSER that could allow assembly a critical mass in a PFP glovebox. Furthermore, the Team was provided a draft revision to the approved CSER which would have further degraded the safety margin had it been approved for use. This indicts the entire program and specifically the capability of FDNW to assure BWHC that it is receiving adequate CSER.

FDNW currently has access to the majority of active criticality safety engineers with PFP experience. It is the judgement of the Team that FDNW has a few highly capable CSE. However, the FDNW and FDH training and qualification programs do not guarantee that PFP will have access to the necessary expertise indefinitely. Compounding this problem is the tendency for FDNW, an enterprise company, to market its technical staff away from Hanford. The Team strongly recommends DOE-RL to require a complete technical review of CSERs, CPSs, and postings prior to approving restart of operations at PFP. FDNW needs to re-evaluate its qualification program to ensure that its most capable CSE are available to perform technical peer reviews. Years of experience should not be the primary criterion for qualification as a peer reviewer. FDNW should utilize outside SME to assess its performance periodically.

The Team found that BWHC management has implemented many elements of a sound criticality safety program. Line management and supervision demonstrated ownership, awareness, and involvement in criticality safety. The capabilities of the current CSR and the CSR-trainee are strong points of the program. The lone CSR at PFP has been tasked with performing almost all the nuclear criticality safety staff responsibilities specified in ANSI/ANS-8.19 with the exception of developing CSER. BWHC management was responsive to the December 1997 DOE review and is working to resolve weaknesses in the implementation of the new initiatives, primarily with the graded infraction program and the utilization of the CSE staff. As the effective utilization of CSE improves, the current excessive responsibility assigned to the CSR should be reduced. Synergy between the CSR and CSE also should yield a stronger NCS program at PFP. Given the limited budget and technical staff and the contractual and oversight environment within which PFP has been forced to operate, BWHC has made a good faith attempt to implement a sound criticality safety program.

However, further improvements in the criticality safety program at PFP will require DOE-RL and FDH to demonstrate leadership in partnership with BWHC. Neither DOE-RL nor FDH have allocated the necessary resources to meet the intent of ANSI/ANS-8.19, Section 1.0, *Management Responsibilities*. For example, site-wide guidance on the training, qualification and professional development of CSE staff has not been issued. Neither DOE-RL nor FDH has a program in place to monitor the implementation of the criticality safety program at PFP with sufficient frequency or depth. There is no advocate for the BWHC criticality safety budget within either DOE-RL or FDH to ensure that PFP has the necessary resources to implement a criticality safety program that meets the expectations of the standards and supports safety of operations. The Team found that there was no focal point for criticality safety within either DOE-RL or FDH. To have an effective program such a champion is needed within both organizations. DOE Policy 450.5, *Line Environment, Safety and Health Oversight*, should be implemented expeditiously at Hanford. Particular attention should be paid to making the following three principles common to both the Department and contractor:

1. Work together to develop ES&H performance objectives, measures, and expectations tied to Departmental strategic goals and objectives, as well as to performance goals and objectives of the Safety Management System elements. Mutual agreement is reached on expected ES&H performance.
2. Work together to develop contract performance measures and performance indicators that are linked to the DOE Safety Management System.
3. Work together to develop a high level of performance assurance which results in improved ES&H performance.

In the absence of effective criticality safety programs at DOE-RL and FDH, consideration should be given to extending the exclusivity clause for FDNW because, even with the above programmatic deficiencies noted, several members of the FDNW criticality safety staff have Hanford and PFP experience and the demonstrated technical ability to provide support to PFP. DOE-RL, FDH, and BWHC should form a partnership to ensure that FDNW provides the best CSE support available to PFP in the near term until specific guidance is developed by FDH to provide necessary NCS technical support in the longer term.

The Team judges the PFP criticality safety program to be deficient with respect to DOE Order 5480.24 and ANSI/ANS-8.19, primarily in the oversight organizations and the subcontractor providing criticality safety support to BWHC. More importantly, the Team has concerns about the criticality safety bases supporting planned PFP operations and recommends these be reviewed independently and revised as needed prior to authorizing restart.

References

1 CSER-96-023, "CSER for PFP Glovebox HC-21A with 4.4 Kilogram Plutonium Cans," Rev. 0, 11/19/96

2 "Operational Implementation of the Criticality Safety Program at PFP," DOE Memorandum McKamy to Knollmeyer, December 23, 1997

3 ANSI/ANS-8.19-1984 (R1989), "Administrative Practices for Nuclear Criticality Safety"

4 WHC-SD-CP-SAR-021, Rev. 0, Plutonium Finishing Plant Safety Analysis Report, December, 1995.

5 DOE Order 5480.24

6 DOE Policy, 450.5, "Line Environment, Safety and Health Oversight"

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Acronyms

AMF	Assistant Manager for Facility Transition
BED	Building Emergency Director
BWHC	Babcock & Wilcox Hanford Company
CAP	Criticality Alarm Panel
CAS	Criticality Alarm System
CIT	Criticality Improvement Team
CPS	Criticality Prevention Specification
CSE	Criticality Safety Engineer
CSER	Criticality Safety Evaluation Report
CSES	Criticality Safety Engineering Staff
CSLEP	Criticality Safety Limit Evaluation Program
CSR	Criticality Safety Representative
DTS	Deficiency Tracking System
ESH&Q	Environment, Safety, Health & Quality
FDH	Fluor Daniel Hanford
FDNW	Fluor Daniel Northwest
FEB	Facility Evaluation Board
FRAM	Functions, Responsibilities, and Authorities Manual
HFD	Hanford Fire Department
IMC	Integrating Management Contractor
MBA	Material Balance Area
NCES	Nuclear Criticality Engineering Staff
NCS	Nuclear Criticality Safety
OSR	Operational Safety Requirement
PFP	Plutonium Finishing Plant
PM	Performance Measure
POD	Plan of the Day
QSH	Quality, Safety and Health (organization)
RCT	Radiation Control Technician
RFETS	Rocky Flats Environmental Technology Site
SME	Subject Matter Expert
TCAS	Temporary Criticality Alarm Systems
TPD	Transition Programs Division